

Figures

November 30, 2020

1 Figures

1.1 What this file is about

In this file, we construct the figures used in the report. These figures include learning curves over the loss or PSNR/SSIM scores of network as well as visualizations of the final upscaled images compared with the HR labels and linearly interpolated versions of upscaled LR images.

For evaluation metrics, the PSNR and SSIM score was used. The PSNR is defined as:

$$PSNR = 10 \cdot \log_{10} \left(\frac{MAX_I^2}{MSE} \right)$$

where MSE is the means squared error between the HR label and network prediction, and MAX_I^2 is the maximum possible pixel value of a monochromatic image.

The SSIM is defined as:

$$SSIM(x, y) = [l(x, y)^\alpha \cdot c(x, y)^\beta \cdot s(x, y)^\gamma]$$

where s, y are the network prediction and HR label, l is the luminance comparison between the two, c is the contrast comparison between the two, and s is the structure comparison between the two.

For the loss, we used the mean L_1 loss:

$$\mathcal{L}(\theta) = \frac{1}{N} \sum_{i=1}^N \|H(I_i^{LR}) - I_i^{HR}\|_1$$

where H is the hypothesis of the model being trained, I_i^{LR} is the i^{th} pixel of the low-resolution image, I_i^{HR} is the i^{th} pixel of the high resolution image, θ are the model parameters, N is the number of pixels in the image, and $\|\cdot\|_1$ is the L_1 norm.

```
[1]: # Import modules
import numpy as np
from RFDN import RF DN, RF DN1
from BaseN import BaseN
from FDCN import FDCN
from compare import Compare
from evaluate import Evaluate
from lc import LearningCurve
```

2 Preliminaries

Here, set up the models, checkpoint files, and data directory to be used by the classes for evaluation purposes. We only consider figures of the RFDN and RFDN1 models, as they are the main models in the report. Additionally, due to the page limit, we cannot include figures of the less important FDCN and BaseN models.

```
[2]: # Set up models and checkpoint/data directories
model1 = RFDN1(nf=10, upscale=2)
model2 = RFDN(nf=10, upscale=2)

checkpoint_file1 = "/home/samuel/Documents/CMPUT511/Project/Checkpoints/
    ↪AvgLearningCurve/RFDN1/checkpoint_40.tar"
checkpoint_file2 = "/home/samuel/Documents/CMPUT511/Project/Checkpoints/
    ↪AvgLearningCurve/RFDN/checkpoint_0_40.tar"

checkpoint_dir1 = "/home/samuel/Documents/CMPUT511/Project/Checkpoints/
    ↪AvgLearningCurve/RFDN1"
checkpoint_dir2 = "/home/samuel/Documents/CMPUT511/Project/Checkpoints/
    ↪AvgLearningCurve/RFDN"

data_dir = "/home/samuel/Documents/CMPUT511/Project/Data"
```

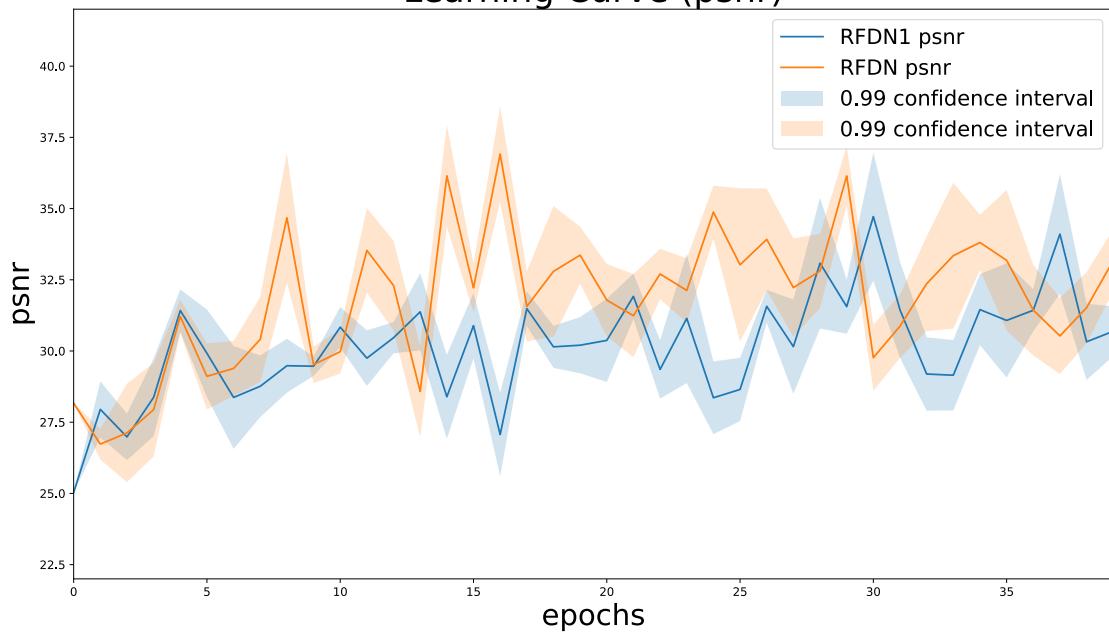
3 Learning Curves for RFDN and RFDN1

Here, we generate the learning curves for the RFDN network and RFDN1 network. These learning curves are of evaluation metrics PSNR and SSIM as well as the loss function.

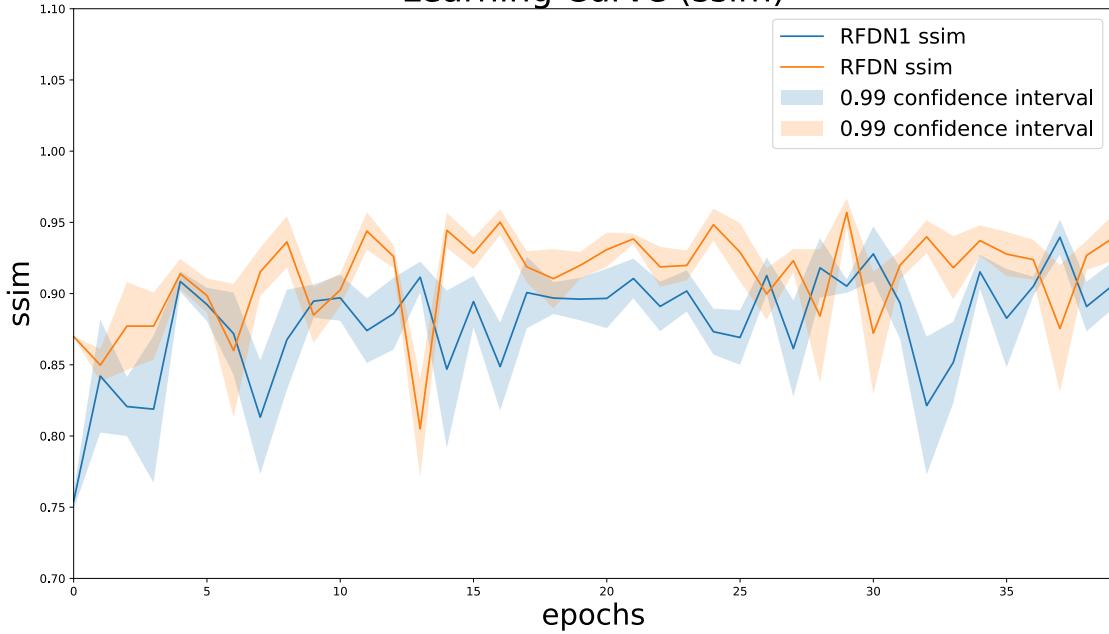
```
[3]: lc = LearningCurve(checkpoint_dir1, checkpoint_dir2=checkpoint_dir2)
```

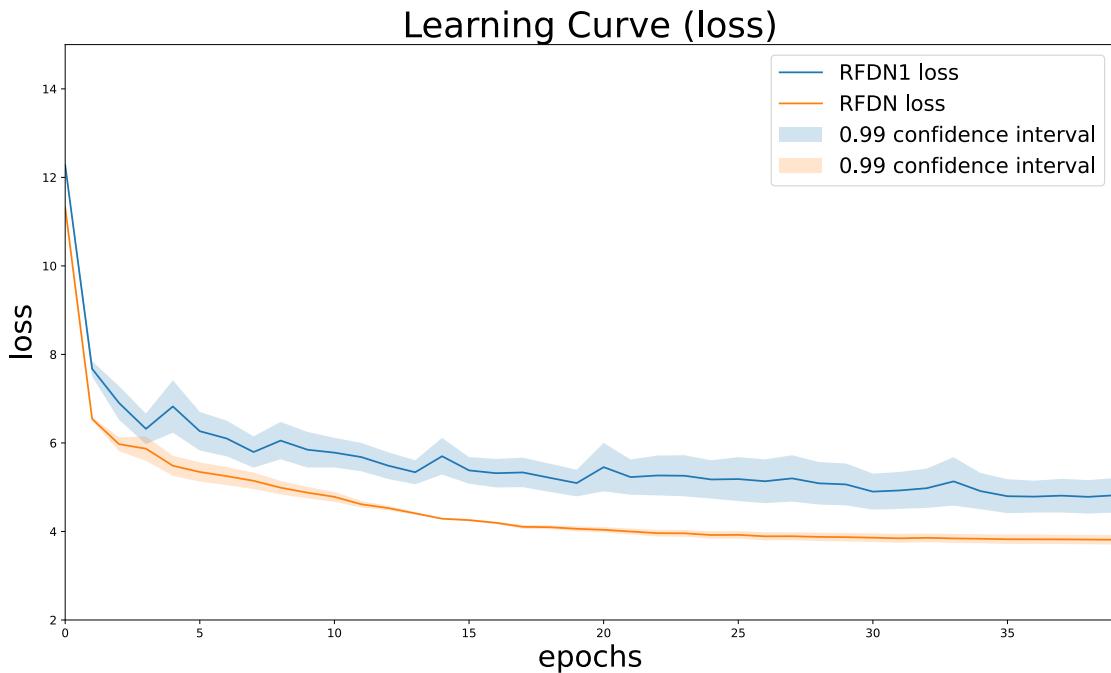
```
[4]: lc.plot("psnr", x=(0, 39), y=(22, 42), label="RFDN1", label2="RFDN")
lc.plot("ssim", x=(0, 39), y=(0.7, 1.1), label="RFDN1", label2="RFDN")
lc.plot("loss", x=(0, 39), y=(2, 15), confidence=0.99, label="RFDN1",
    ↪label2="RFDN")
```

Learning Curve (psnr)



Learning Curve (ssim)





4 RFDN/RFDN1 compared to the high resolution label

Figures comparing the output of the RFDN and RFDN1 networks to the HR labels

4.1 RFDN1 Comparisons

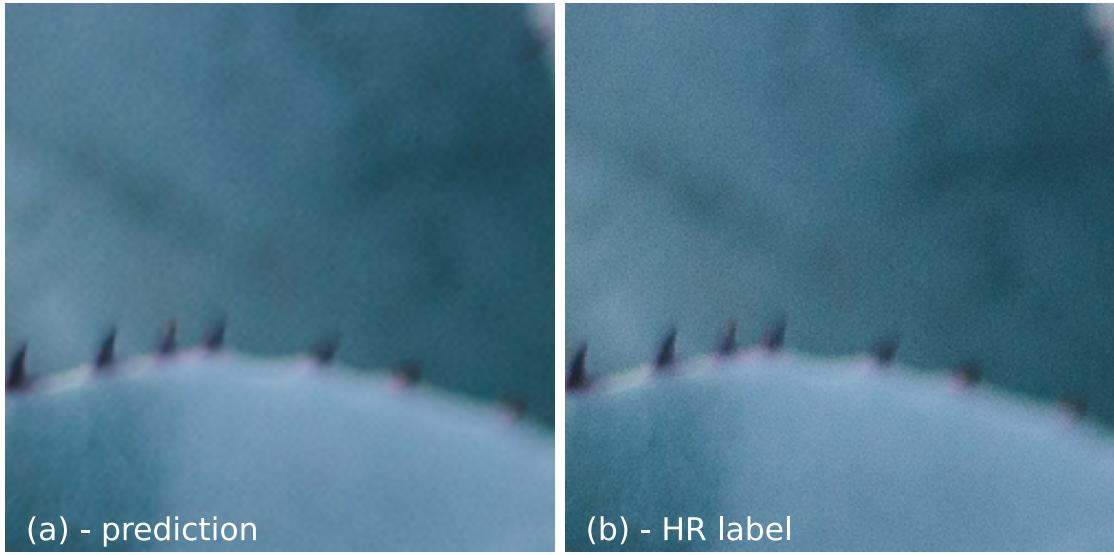
```
[5]: # RFDN1
e = Evaluate(model1, checkpoint_file1, data_dir)
```

```
[6]: e.compare_patches(56, size=250, start=(110,200))
e.predict(56, img_name="", save_img=False)
```

PSNR: 35.750933674448994

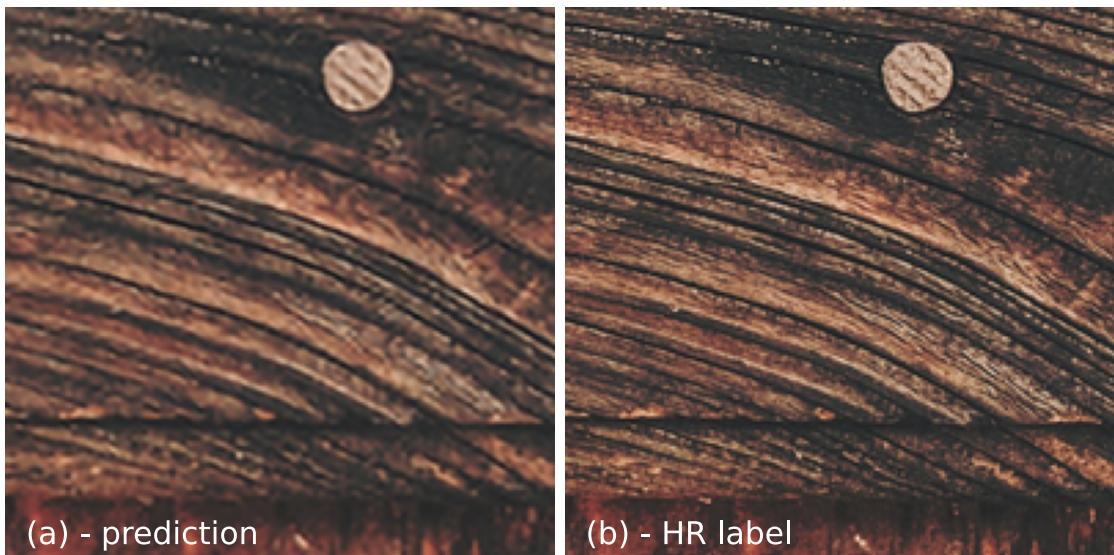
SSIM: 0.8271939158439636

Average Loss: 5.093774834459648



```
[7]: e.compare_patches(84, size=200, start=(700, 770))  
e.predict(84, img_name="", save_img=False)
```

PSNR: 26.18034292448521
SSIM: 0.8215885162353516
Average Loss: 5.093774834459648

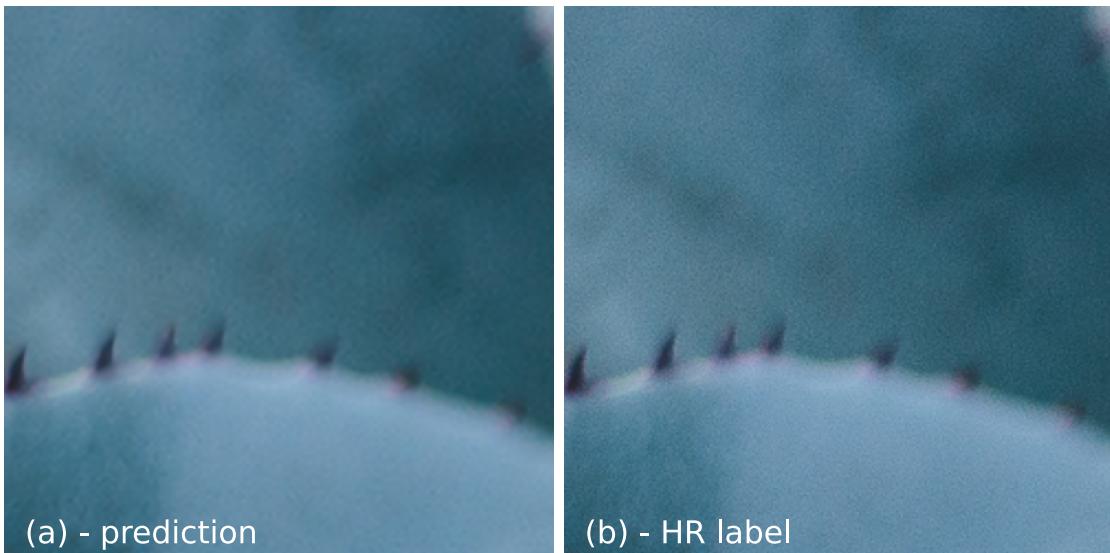


4.2 RFDN Comparisons

```
[8]: # RFDN  
e2 = Evaluate(model2, checkpoint_file2, data_dir)
```

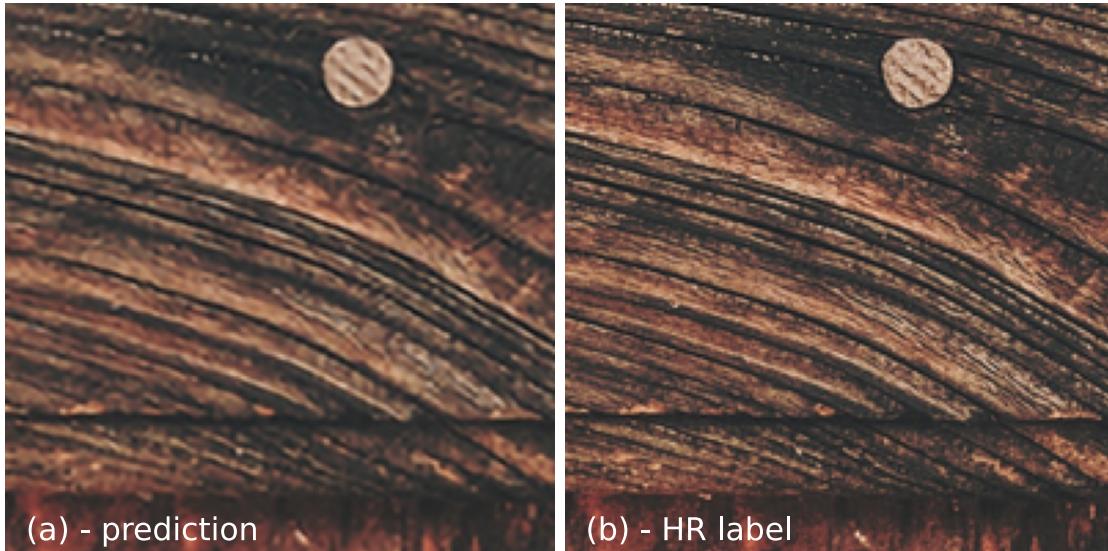
```
[9]: e2.compare_patches(56, size=250, start=(110,200))  
e2.predict(56, img_name="", save_img=False)
```

PSNR: 35.897698545165014
SSIM: 0.8268753886222839
Average Loss: 4.536314880115912



```
[10]: e2.compare_patches(84, size=200, start=(700, 770))  
e2.predict(84, img_name="", save_img=False)
```

PSNR: 26.333213845284305
SSIM: 0.8255494236946106
Average Loss: 4.536314880115912

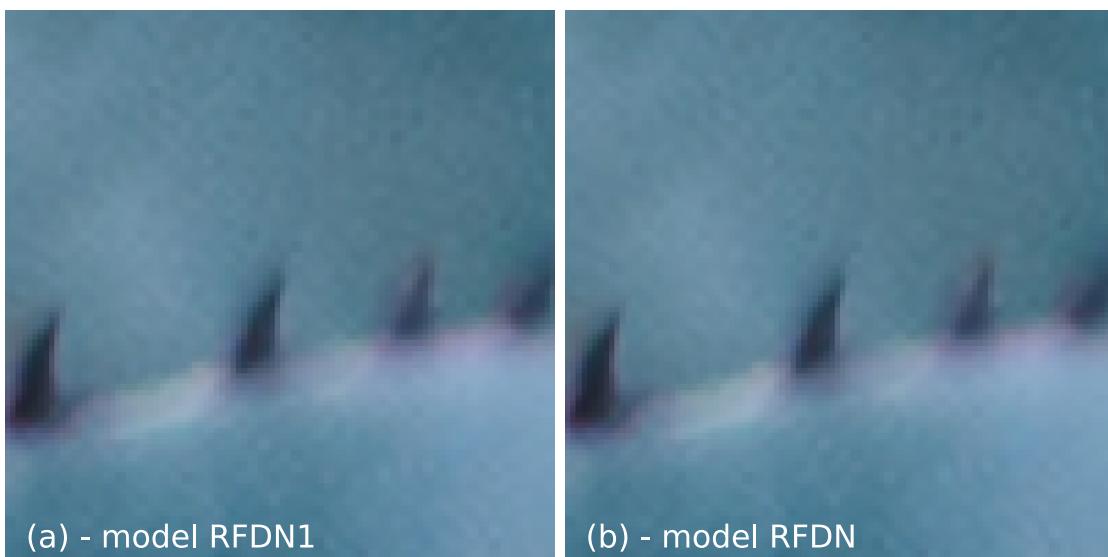


5 RFDN1 vs RFDN

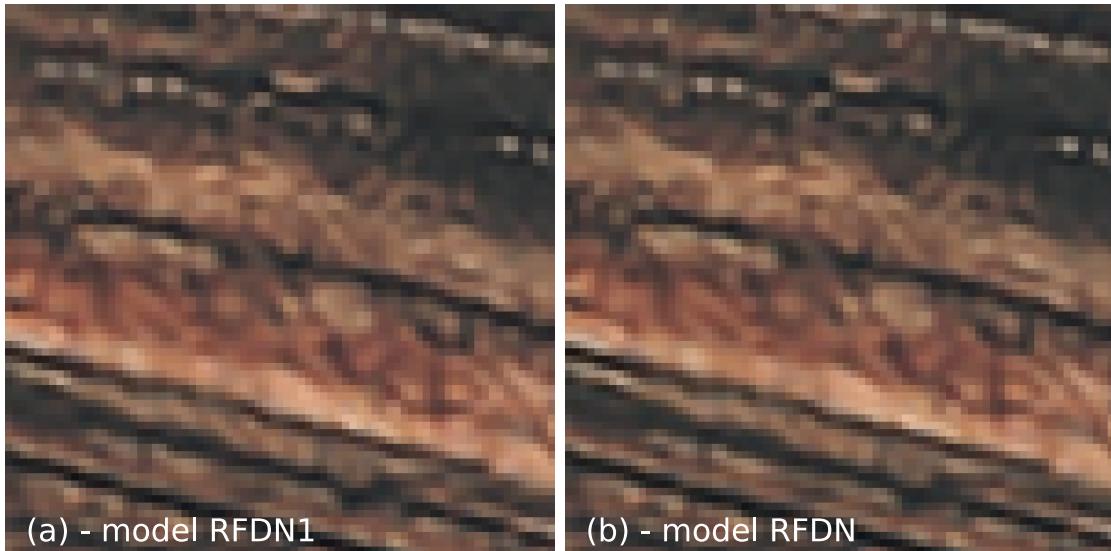
Here we generate figures comparing the outputs of the RFDN and RFDN1 networks.

```
[11]: comp = Compare(model1, model2, checkpoint_file1, checkpoint_file2, data_dir)
```

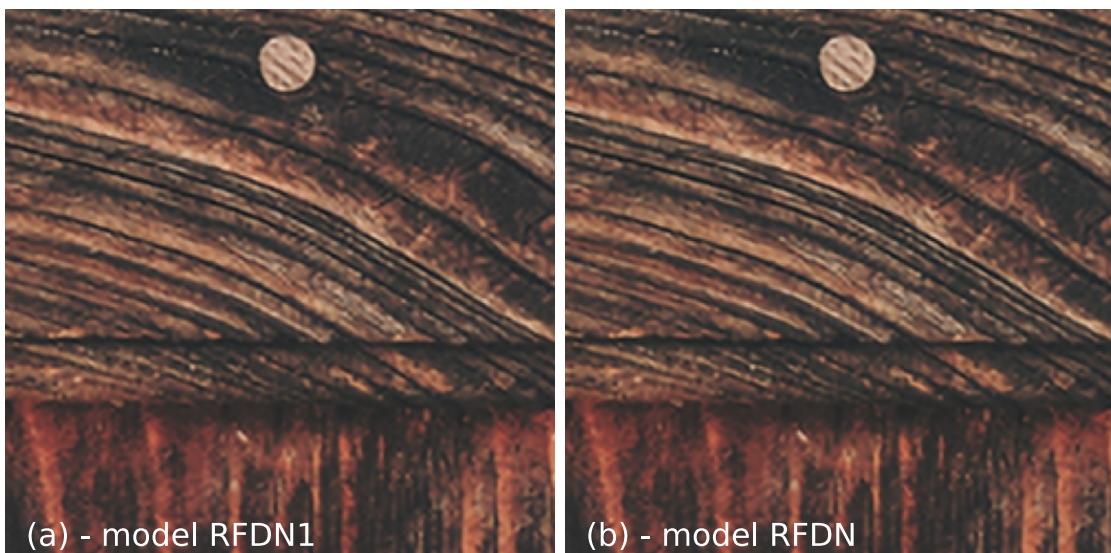
```
[12]: # You can see the shadow on the leaf in RFDN network better represented
       comp.compare_patches(56, size=100, start=(210,200))
```



```
[13]: # Shadows in RFDN seems to be a bit better  
comp.compare_patches(84, size=75, start=(700,770))
```



```
[14]: comp.compare_patches(84, size=250, start=(700,770))
```

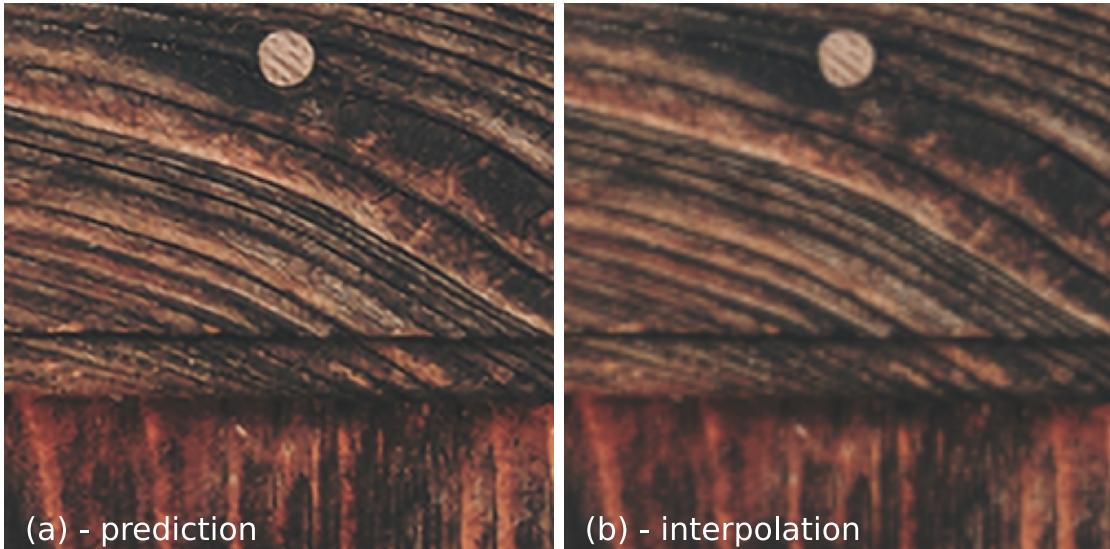


6 Interpolation vs RFDN/RFDN1

Here, we plot the figures comparing traditional interpolation techniques vs the RFDN and RFDN1 networks

6.1 RFDN1

```
[15]: # RFDN1  
e.compare_interpolation(84, size=250, start=(700,770))
```



6.2 RFDN

```
[16]: # RFDN  
e2.compare_interpolation(84, size=250, start=(700,770))
```

